POTASH SALTS

Their Origin and Occurrence

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This theory of Walther we shall designate as the "Theory of Eolian Deposition" of protective cover.

Those geologists who advance the other theory which we designate as the "Theory of Aqueous Deposition" argue that after the most readily soluble group of salts had deposited as a surface layer, sediments were carried into the salt basin. These so rapidly deposited, as a protective covering, near the mouths of the inflowing streams that at least a portion of the previously formed potash salts did not have time to redissolve and were thus effectively preserved.

The agencies of both wind and water play at the present time an important role in the development of protective coverings for salt beds. In some arid places one agent predominates, in other regions the other agent is the more important factor. In the conservation of the potash deposits, however, the evidence thus far accumulated by investigators leads us to favor the view that the wind was by far the more important agent.

Potash Deposits Near Stassfurt, Germany.

Since the Stassfurt deposits supply practically all the potash used in the world's chemical and technical industries it may be profitable to give a brief account of these deposits, their occurrence and their origin.

The town of Stassfurt became noted for its salt works in the beginning of the last century, at which time the source of the salt was the natural brine obtained from driven salt wells. In 1852 the Prussian government commenced the sinking of a shaft, which, in 1857, at a depth of 1,080 feet, penetrated a thick bed of rock salt (sodium chloride). Before reaching this bed, however, the shaft cut a thick bed of the so-called "abraum-salze" or refuse salts. They were thus designated since their value at that time was not appreciated. These refuse salts, which now constitute the most valuable known potash salt deposit on the earth, besides many other salts of minor commercial value, contain the following potash-bearing salts: carnallite, which is a double chloride of potassium and magnesium; sylvite, which is a potassium chloride; and kainite, which is a mixture of potassium chloride and magnesium sulphate (epsom salt.)

The deposits occur in the upper Permian system of sedimentary rocks and have been found by means of numerous borings and shafts to occupy a series of basins or synclines which extend in a southwesterly direction from the neighborhood of Stassfurt to the river Rhine. There were in this area in January, 1911, 69 salt mines in operation and new mines are occasionally discovered. Over most of this explored area the deposits consist of at least one complete series of salt beds; i. e., the deposits consist of an underlying bed of gypsum or anhydrite followed by the more common salts and capped by the potash salt carnallite. In some places there occurs a second complete series separated from the lower by an impervious layer of clay.

At Stassfurt the order of deposits from the surface downward as shown in the following profile taken from Credner is as follows:

1—Glacial drift, from a few to 25 feet thick.

2—Beds of clay, shale and sandstone (Triassic) of varying thickness.

3—Younger rock salt—masses of lenticular shape.

4—Anhydrite, 100 to 260 feet thick.

5—Salt clay, 16 to 33 feet thick.

6—Carnallite (potash salt), 50 to 130 feet thick.

7—Kieserite zone (magnesium sulphate).

8—Impure rock salt (polyhalite zone).

9—Older rock salt with thin layers of anhydrite.

Total thickness of these three beds varies from 500 to 3,200 feet.

10—Gypsum and anhydrite.

(Anhydrite is the same in composition as gypsum, with the water of crystallization removed.)

The carnallite beds constitute only a small part of the total thickness of the salt deposits as shown in the above table. The horizontal extent, however, of the beds is so great that Ochsenius has calculated that the deposit of potash salts in Germany may last at least 600,000 years.

Origin of the Stassfurt Salts.

Different theories have been advanced to account for the origin of the Stassfurt and other great salt deposits. Yet it is the consensus of opinion that they were formed during prolonged periods of aridity. The theory of Ochsenius is, in brief, that deep bays existed which were connected with the sea by narrow, shallow channels through which the sea water entered and offset the losses by evaporation. The salinity of the water gradually increased until the saturation point was reached and salts began to deposit. As long as the inflow of salt water continued the less soluble salts kept accumulating in the deeper parts of the basins until they became solid masses of salt, covered by a sheet of bittern which contained the potash salts. An elevation of the land now occurred which completely isolated the bays from the ocean, evaporation proceeded to its limit and the more soluble salts, including the potash salts, deposited in a layer on the top of those previously formed. This process of inflow, evaporation and concentration is now in actual operation in the Karabugaz on the east side of the Caspian sea, but the more soluble salts have not yet commenced to deposit in this bay. A protecting layer of clay was finally laid down over the potash salt layer. After this the sea either had access to the basin and a new series of salt beds formed or else, as some believe, the old salt beds in some places were dissolved and redeposited in other places on top of the first series. Hence the occurrence of two series in some areas around Stassfurt.

Caspian Sea and Karabugaz.

The Caspian Sea is an isolated part of the ocean. It covers an area of 75,000 square miles, is from 2,000 to 3,000 feet deep and its surface is 85 feet lower than that of the Mediterranean sea. At the time of its isolation from the sea the per cent of salt held in solution must have been about the same as that found in the ocean waters today. Although the surface has been lowered 85 feet through evaporation since the time of isolation, while several large rivers, among them the Volga, have since that time continued to carry immense quantities of salts into this sea, yet the per cent of salts in its waters is less than that found in the open sea. The explanation of this condition is found in the study of processes now going on in the bays and lagoons on its shores.

The largest and in some respects the most noted body of saturated salt solution known is that of the Karabugaz. This body of water, which might very appropriately be called a natural salt pan, is a bay, about as large as Great Salt Lake, which has been isolated from the Caspian Sea by means of a sand bar. The two bodies are connected by a channel through which there flows continuously into the bay a current of water 450 feet wide and five feet deep. This current carries daily, according to careful estimates, into the bay 350,000 tons of salt, or yearly 128,000,000 tons. The climate in the region of the Caspian is arid and similar to that of western Utah. The evaporation equals the inflow and the water level stands practically stationary in the sea and its lagoons. The water of the Karabugaz carries 28 per cent of salts in solution. Vast quantities of sodium chloride and sodium sulphate are now crystallizing out and depositing on the bottom, while around the shores of the bay crusts of gypsum are forming. During the drier parts of the season the desert winds carry large quantities of dust into the bay. Alternating layers of salts and clay are thus depositing on the bottom. The conditions appear here exceptionally favorable for the development of a great salt bed. The brine has not reached the point of saturation for the potassium magnesium salts, hence these have not commenced to crystallize out. Should the inflow of water ever be stopped by the shifting sands on the bar the last named salts would eventually deposit on the top of the more common salts, and there would occur a bed, consisting of a complete series of salts similar to the deposit at Stassfurt.

Great Salt Lake and Sevier Lake.

Coming now nearer home, we find processes going on as interesting and instructive as those we have considered above. Great Salt Lake is a descendant of a much larger lake named after an early explorer Lake Bonneville. Evidences of the existence of such an ancient lake are found in the well developed shore terraces seen near the foot of the mountain range just east of Ogden and in the stratified deposits exposed in the bluffs along the Weber river from West Ogden to Uintah. The highest of these terraces is about 1,000 feet higher than the present surface of Great Salt Lake, and it has been traced from Cache valley in the north to the south end of Escalante valley in the south, a distance of more than 300 miles. As shown by the highest terrace Lake Bonneville had an extreme length from north to south of 346 miles and an extreme width from east to west of 145 miles. It covered an area of 19,750 square miles and had a maximum depth of 1,050 feet. When the lake stood at its highest level it discharged its waters into Snake river, through what is known as "Red Rock Pass" in the north end of Cache valley. The Oregon Short Line railroad follows this pass for some distance and thus secures an easy grade from Cache valley into Idaho. After the lake had stood at its highest level a great period of time the outlet channel was rapidly deepened 375 feet and the surface of the lake was lowered by the same amount. While the lake stood at this lower level the wide, well developed terrace, seen just above the city reservoir east of Ogden, developed. This terrace has attained its greatest development just north of Provo, where it constitutes what is known as Provo bench. It has, therefore, been named the Provo terrace.

As a consequence of a gradual change in climate from one of great humidity to one of aridity, the evaporation, in time, began to exceed the inflow. The outflow through Red Rock Pass ceased, the water began to get salt and in the course of time only three small remnants of this great body of fresh water were left, viz: Great Salt Lake, Utah Lake and Sevier Lake.

Great Salt Lake in 1869 covered an area of 2,170 square miles (about 1-9 the area of Lake Bonneville), had an extreme length of 83 miles, a width of 59 miles and a maximum depth of 49 feet. Since the first settlement was made in Utah the surface of the lake has continuously oscillated. The lowest recorded stage of the present lake occurred in 1850. With the changes in level since 1847 there has occurred corresponding variations in the per cent of salts held in solution. As far as observations have been carried on the point of saturation has, since that date, never been reached in the open lake for any salts except for lime and gypsum. It is evident, however, that the water must be near the saturation point for sodium sulphate (glauber salt) since this crystallizes out in great quantities in winter, when the temperature is low. No permanent deposit of this salt forms, however, since with the rise in temperature it immediately dissolves.

Per Cent of Salts in Great Salt Lake.

When the lake was at its lowest recent stage in 1850 the brine contained 22.4 per cent salts. When it reached its highest stage in 1873 the salt content of the brine was 13.7 per cent. In 1885 and also in 1889 Dr. Talmage made complete analyses of carefully selected samples of brine. In the first named year he found a total salt content of 16.7 per cent and of this 16.7 per cent he found 2.6 per cent of potassium sulphate and 80 per cent of sodium chloride. Basing his calculations on the above analysis and on measurements made by himself, Gilbert found that the water in the lake contained in solution 400,000,000 tons of sodium chloride and 30,000,000 tons of sodium sulphate (glauber salt).

Using the data given by Dr. Talmage and Dr. Gilbert as a basis for calculation, the writer of this article has found some interesting results. Since the 400,000,000 tons of sodium chloride equals 80 per cent of the total salts there must be in solution 500,000,000 tons of salts, and since 2.6 per cent of this total amount equals potassium sulphate, the amount of the last named salt present must equal about 13,000,000 tons. This amount of potassium sulphate estimated in terms of potassium oxide (potash) gives a total potash content of 7,000,000 tons. Upon multiplying this quantity by $35, the approximate present value of potash per ton, we find that the waters of the lake contain in solution $240,000,000 worth of potash. There is no process known, however, by which the potash can be profitably extracted. The interposition of human agency may, however, hasten the time when these valuable salts may become available. Gilbert estimated that the volume of water in the lake in the '80s was equal to the inflow in about 3 1-2 years, and that Bear river supplied about 1-2 of the total amount. Were all the waters of the Bear, the Provo and the Weber rivers stored in reservoirs the brine would soon become concentrated, the salts would begin to deposit on the bottom and, in a few years, the bed would become perfectly dry and remain so at least during the dry season. It appears true that a small amount of water is supplied by springs and hence over the dry basin there might remain small pools of brine even during the drier part of the year. Should these results ever be brought about the potash salts would be found in favored localities as a capping to the more common salts. That human agency is capable of bringing about such results has been practically demonstrated in the case of Sevier lake, the southern remnant of Lake Bonneville.

Sevier Lake.

In 1872 Sevier lake, situated in Millard county, this state, was 28 miles long, covered an area of 188 square miles and had a maximum depth of 15 feet. The brine at that time contained 8.64 per cent of salts. In consequence of the diversion of the Sevier river, which furnished the principal inflow, the lake has since 1880 been reported as dry during the summer months. The salt crust formed on the bottom varies from four to five inches in thickness and covers an area of 40 square miles. The sodium sulphate occurs concentrated in the middle of the basin, while the sodium magnesium chlorides and potassium sulphate are found concentrated near the margin. The salts near the margin carry about 1 per cent of potassium sulphate.

Salt Beds in Western Utah.

A recent decision of the United States supreme court, determining the ownership of the bed, has directed considerable attention to a surface salt deposit in western Utah near the Nevada boundary line. The deposit occurs near Wendover on the Western Pacific railroad and is said to occupy one of the old Lake Bonneville basins. An Ogden civil engineer who recently examined this deposit reports to the writer that it averages five feet in thickness and that it covers an area at least 10 by 6 miles, or 60 square miles. The bed carries a large per cent of clay, hence it would not average more than two or three feet in pure salt. Since the waters from which this salt bed deposited were a concentrated portion of the ancient Lake Bonneville waters the same salts must have been present in it which now occur in Great Salt Lake. A systematic examination of this deposit might therefore result in the discovery of deposits of potash salts.

Since the potash magnesium salts are normally the last to deposit from a brine these salts would naturally be looked for as a surface layer capping the sodium chloride in places where the final deposits occurred. As far as we have been able to learn this deposit has been studied only in respect to its sodium chloride content.

Theoretical Considerations.

Not only do the above considered facts suggest the possibility of discovering salt deposits, including potash, in all the more important minor basins covered by Lake Bonneville, but these facts in addition to certain others, which we are about to discuss, suggest the existence of a succession of at least two series of salt beds in some basins. The study of clay and marl deposits formed in the bottom of Lake Bonneville led Gilbert to the discovery of land deposits of considerable thickness lying between two series of lake deposits. This discovery led him to conclude that a period of aridity intervened during the Bonneville period; that the basin became largely dessicated, and that the major part of the salts held in solution were precipitated in the lowest parts of the basin. He furthermore infers that occasional floods covered the salt beds with a protective layer of clay and sand and that they were not redissolved when the basin, during the late Bonneville period, again filled with water.

Corroborative proof in support of the theory of an inter-Bonneville period of aridity has been discovered in the basin of Great Salt Lake since the classic work on Lake Bonneville was written in 1890.

During the winter of 1892-3 the discovery of such a buried and protected bed of salt was made on the shore of the lake 12 miles west of Salt Lake City, where the great Saltair pavilion now stands. Mr. Hardy, the engineer in charge of the building of the railroad track to the pavilion, informed the writer, at the time of the construction, that a bed of salt covered with a layer of sand and clay, was encountered which interfered materially with the progress of the work. The bed varied in thickness from 4 to 7 feet and extended from the shore out under the water as far as the point where the work was carried on, a distance of something over a one-fourth of a mile. The thickness of the bed and its compactness were so great that the piles on which the track was laid and the pavilion built could not, even when iron shod, be forced through it with the piledriver. Not until holes had been made through the salt bed by means of the dissolving action of steam, conducted in pipes down through the brine, could the work of piledriving be prosecuted. This bed, as far as determinations have been made, consists chiefly of sodium sulphate (glauber salt). As far as we know no attempt has been made to determine the extent of this deposit, nor has any detailed work been done to determine the existence of potash salts. The existence of potash in this bed appears extremely doubtful. The protective covering at Saltair, while effective in preserving the glauber salts, would not be such for the more soluble potassium magnesium salts. If these last named salts were ever deposited they must have been redissolved when the basin refilled with water, unless they were protected by a thicker or more impervious covering.

Salts in Playa Lakes.

Playa lakes are shallow bodies of water common in the great basin between the Wasatch and Sierra Nevada mountains. These lakes frequently evaporate to dryness and leave perfectly level and even surfaced mud plains. As shown by Russell in his monograph on Lake Lahontan the deposits on these mud plains frequently contain a large per cent of salts. The salts in many places were found so intimately incorporated with or else so completely covered by clay, that they do not redissolve when the basins become filled with water. The depth to which these deposits extend varies from a few up to a thousand or more feet.

The study of these playa salt deposits led Russell to the conclusion that many ancient salt deposits of the earth have originated from ordinary river waters evaporated in playa lakes, and not from sea water. This theory, however, hardly seems applicable if advanced in explanation of the origin of thick beds of nearly pure salts covering wide areas, such as those worked in Germany and Poland.

Lake Lahontan.

Lake Lahontan is the name given to an ancient lake which covered a considerable portion of western Nevada, near the foot of the Sierra Nevada mountains, during the time of the existence of Lake Bonneville in Utah. This western lake received the drainage from a considerable portion of the east slope of the Sierra Nevada mountains and has left evidences of its existence in sedimentary deposits and in the high terraces on the rim of its basin. It was considerably smaller than Lake Bonneville and attained a maximum depth of 886 feet. The lake filled a compound basin or rather a series of basins which were connected by narrow channels. As far as known it never had an outlet to the sea and hence all the salts carried into its basin, from the beginning of its existence to the present time, must exist either as deposits in the basin floor or else in solution in the small existing lakes.

In view of this fact we would naturally expect that those remnants of this ancient lake which have no outlet would consist of saturated brines or at least of brines concentrated to the same degree as those of Sevier and Great Salt Lake. It is surprising, therefore, to find that in the larger of the seven existing lakes the salinity is so low that animals can drink the water without experiencing any evil effects. Pyramid lake, as an example, has no outlet and receives a great inflow from the Truckee river, yet its salinity is so low that, according to Russell, a variety of trout and several species of mollusks flourish in its waters. Even at the northern end where the degree of salinity must be the highest since it is farthest away from the mouth of the inflowing river, cattle drink the water without injury.

Cause of Low Salinity in Lakes.

As an explanation of the low degree of salinity where we would expect to find saturated brines, Russell adopts Gilbert's view that such conditions are accounted for by the hypothesis that the salts were deposited and buried by clays during periods of aridity. This statement amplified means that during the dry season the waters completely evaporated and beds of salt formed on the bottom. During the wet season the salt beds became covered with a shallow layer of brine from which layers of clay deposited on the undissolved portions of the salt beds. Through a repetition of this process during a series of years or even of centuries all the salts became completely buried and the lakes became playas. Since these playa lake basins began to contain permanent bodies of water, in consequence of the increased humidity of the air, sufficient time has not elapsed for the waters to reach a high degree of salinity.

The United States geological survey evidently considers the conditions in the Lahontan basin more favorable for the discovery of potash salts than they are in any other part of the great basin. The survey recently started deep drilling in this basin near Fallon, Nev., for the purpose of prospecting for those salts. The hole had reached some time ago a depth of about 300 feet, but as far as we know no conclusive results have yet been reached.

It has been estimated that there are something over 60 closed basins in the great basin region, the majority, if not all, of which were filled with water during the Bonneville (glacial) period. In many of these basins conditions may have been favorable for the deposition of potash salts.

Owen and Mono Lakes.

Owen and Mono lakes are situated on the east slope of the Sierra Nevada mountains in eastern California and not far from the Nevada-California boundary line. These lakes have no outlet and since the waters now flowing into them will soon be diverted the process of extinction will be notably hastened.

According to Phalen the water of Owen lake contains, in addition to the large quantities of sodium chloride, borax and carbonate of soda, about 8,000,000 tons of potassium sulphate which we have calculated equals about 4,500,000 tons of potash. The ancient shore line of this lake, nearly 200 feet higher than the present water surface, shows that the lake formerly covered a much greater surface. Mono lake, situated at an altitude of 6,730 feet above sea level, covers an area of 85 square miles and has an average depth of about 60 feet. It has been estimated that this lake contains, besides the many other salts held in solution, 10,538,100 tons of potassium chloride, which equals about 8,000,000 tons of potash. The old shore line of this lake is 670 feet higher than its present water surface.

Investigation of Bitterns.

During 1911 the United States geological survey commenced a systematic survey of the brines, bitterns and rock salts of the states east of the Rocky mountains with the view of discovering potash salts. It had been known for years that small quantities of potash salts occur in many eastern salt deposits but no systematic search has ever before been undertaken for the discovery of these salts in commercial quantities. Experts of the survey visited the principal salt producing districts in New York, Ohio, West Virginia, Pennsylvania, Kansas, Louisiana and Michigan and collected samples of salts and solutions. A considerable number of the samples collected were analyzed during the year and the survey recently issued a preliminary report on the results of the investigation. The results show the presence of small quantities of potash salts in nearly all the bitterns examined. The largest quantities were found in the bitterns in certain districts in New York, Michigan and Ohio, but the per cent of these salts present was so low that they are of no commercial importance. The most promising field found occurs on the shores of Lake Erie, near Cleveland, O. The bittern examined at this place was found to contain 0.47 per cent of potash (K_2O). That means that in every 100 pounds of brine there occurs about one-half pound of potash. The commercial value of this bittern as a source of potash, according to the author of the survey report, will depend largely upon the discovery of some cheap method of eliminating the lime and the magnesia from the solution.

Potash in Alunite.

The value of alunite as a source of available potash has no where until recently been recognized, and no attempt has been made in this country to save or utilize this mineral. Since Ransome discovered alunite intimately associated with the gold ores at Goldfield, Nev., about six years ago mining men and geologists have devoted more attention to the study of this mineral. In Europe this mineral has been considered as an important source of alum for several centuries. The most noted deposits occur associated with trachytic rocks at Tolfa, about 35 miles northwest of Rome, Italy. There deposits have been worked since the year 1460 and the alunite mined there has been much sought for, on account of its high degree of purity, by European alum manufacturers.

Alunite is a decomposition product of feldspar, and occurs usually in veins which either cut igneous rocks or are closely associated with such rocks. In structure the mineral is usually either granular or else earthy, similar to kaolin, and its color is usually white, yellow, reddish or gray. When pure it is soft, but when associated with silica it may be almost as hard as glass. In its natural state alunite is practically insoluble in water and in acids. When the roasted mineral, however, is treated with water the potassium sulphate passes into solution, while the aluminum oxide remains insoluble.

Alunite in Utah.

A deposit of alunite near the town of Marysvale, Piute county, Utah, has recently attracted the attention of the United States geological survey and the public in general. The deposit has been known for several years, but not until recently has it been recognized as a possible source of potash. The outcrop occurs on the mountains seven miles southwest of the town, at an elevation varying from 9,900 to 11,000 feet above sea level. The mineral occurs as a compact, light colored, fine grained rock in a large fissure vein which intersects a flow of igneous rock (andesite).

The outcrop of the main vein has been exposed, at intervals, a distance of about 3,500 feet by means of trenches, shafts and tunnels. It has been conservatively estimated that throughout this total distance the vein averages in thickness about 10 feet. The potash content of the mineral as given by the government survey varies from 9.71 to 10.46 per cent. The samples analyzed were, however, selected and give perhaps an exaggerated value of the vein as a whole. Running parallel with the main vein and a few feet from it occur smaller alunite veins which in places show a thickness of 6 feet. As a source of available potash this deposit gives promise of becoming an important factor in supplying the American market with this valuable salt.

The deposit was examined by Messrs. Butler and Gale of the national survey during 1911 and a comprehensive report on the results of their investigation has recently been published.

While engaged in field work in geology last summer the writer of this article found evidence of alunite deposits in the Wasatch range just east of Ogden. The field and laboratory investigations are, however, not yet sufficiently advanced to justify any conclusion respecting the extent and value of the deposits.

Potash in Seaweeds.

It has recently been found that the giant seaweeds growing on the coast of California are rich in potassium chloride. Secretary of Agriculture Wilson is reported as authority for the statement that 1,000,000 tons of potash worth $35,000,000 can annually be extracted from the seaweeds covering 100 square miles of surface on said coast. It has been claimed that an amount of seaweeds necessary to produce that amount of potash could be collected annually for an indefinite number of years, without decreasing the crop, since the rate of reproduction would equal the rate of removal. The secretary, however, has suggested no cheap process of extraction. The present cost of extracting the potash appears to preclude the possibility of making the business a financial success.

Discovery Near Mojave Desert.

During last month paper reports were current to the effect that a great deposit of potash salts had been discovered near Mojave desert, Cal., by representatives of the geological survey. Until the survey makes a report we have no reliable data on which to estimate the extent and value of the deposit.

Age of Salt Deposits.

The salt deposits of the earth are not confined to the formations of any particular age, but may occur in any formation from the Cambrian to the most recent. The following table gives a few prominent salt deposits and the formations in which they occur:

Salina and Syracuse deposits in New York and those of India—Silurian.

Winchell, Michigan and China—Devonian.

New River, W. Va., and Bristol, England—Carboniferous.

Stassfurt, Germany and Texas—Permian.

Tyrol, Austria, Cheshire, England, and Kansas—Triassic.

Algeria—Cretaceous.

Louisiana, Spain and Poland—Tertiary.

Karabugaz, Dead Sea and basins in western United States—Recent.

Thickness of Deposits.

The thickness of salt beds vary from a few inches to several thousand feet. They lie either on the surface, as in some desert regions, or they lie buried at such depths that they can be reached only by means of deep borings. The salt beds in the Stassfurt district attain a maximum thickness of 3200, those at Sperenberg, near Berlin, 4000, and those at Wieliczka, in Galicia, 4500 feet. The Salina beds in New York consist of 250 feet of solid salt occurring in several distinct beds. These beds lie buried under 1,500 feet of later strata.

Summary.

The existence of several lakes in the western states, and especially in the great basin, whose waters contain considerable quantities of potash salts, suggests the possibility that other lakes may at one time have existed, but have entirely disappeared through evaporation. The salt beds formed in these ancient lake basins may hence lie buried at various depths below the surface. Some of the existing lakes containing potash salts are now in the process of extinction, as shown by the old shore lines at various altitudes above the present levels of the lakes. The diversion of the water flowing into these lakes for irrigation purposes will very notably hasten this process and the time is not far distant when the salts held in solution will begin to deposit. The search for potash salts involves a thorough investigation of all discovered salt deposits, since beds of common salt may either overlie or else underlie deposits of potash salts, as shown in the discussion of the Stassfurt deposits. A comprehensive search would include an examination of the following: (1), Potash bearing rocks and minerals in veins; (2) surface salt beds, (3) buried salt beds by means of deep drilling, (4) brines and bitterns from salt wells. The writer knows of no simple field tests for potash salts which would give reliable results. The detection of these salts usually requires a careful chemical analysis.